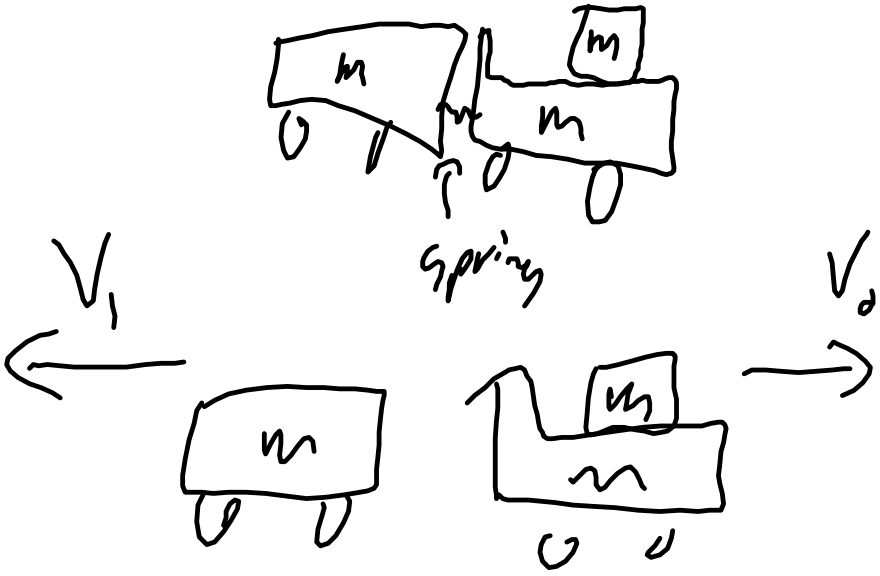
Momentum and Impulse

demo:

2 carts with a spring between them

When I let go, they spring apart.

If one cart has more mass than the other, it springs off with a lower velocity.



$V_1 > V_2$ since $2m > m$

$F = ma \quad a = \frac{\Delta V}{\Delta t}$

This lends itself to discussing the carts mass and velocity together. This is momentum

Momentum is the product of mass and velocity. (particles) It is a vector!!

symbol: p for momentum (why? m was taken)

equation: $p=mv$

units: kgxm/s = kgm/s doesn't have a special unit

Impulse: a change in momentum caused by a net force acting over a period of time.

$\Delta p = F_{net}\Delta t = p_f - p_i$ area under a F-t graph

units: Ns or kgm/s ($N=kgm/s^2$ so Ns = $Kgms/s^2$ = kgm/s)

eg. A 0.450 kg baseball is moving at 100 miles/hour
= 100 miles/hour(1600m/mile)(hour/3600s)
100x1600/3600=44.4444 44.4m/s

you hit it with a bat and goes back at 50.0m/s If the baseball was in contact with the bat for 0.0200s,

a) what was the momentum of the baseball before and after being hit. momentum is a vector!

p=mv = 0.45x44.4=19.98 20.0kgm/s before
0.45x-50=-22.5 kgm/s after (opposite direction)

b) what is the impulse on the ball? What is the impulse on the bat?

impulse = Δp = pf-pi = -22.5-19.98=-42.48
= -42.5kgm/s or -42.5Ns on the ball.
on the bat it will be +42.5Ns on the bat.

c) what is the force on the ball? on the bat?

F=Δp/Δt = -42.5/0.02=-2,125.0 =-2.13kN
the bat will be equal and opposite = 2.13kN

a) super keener: if the force increases and decreases linearly, sketch a f-t graph.

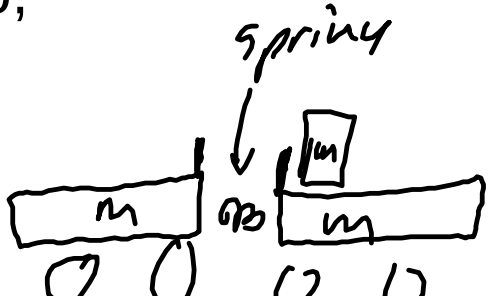
Homework: p178-180 Q1-4, CR 1.1-1.4
next class = conservation of momentum
Thursday lab - spring carts + air track

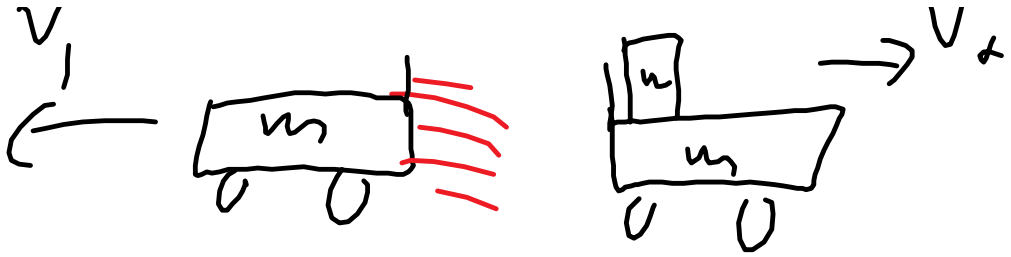
Momentum and Impulse

demo:

2 carts with a spring between them

When I let go,





$V_1 > V_2$ since $M+m > m$

The smaller mass moves off at a higher speed because the two carts experience equal and opposite forces, a=F/m bigger m smaller a
a=Δv/Δt both experience the force for the same time.

This concept of mass and velocity together is useful, so we give it a special name: momentum

momentum is the product of mass and velocity. it is a vector quantity - has direction

symbol: p (why p? M was taken)

equation: $p=mv$
units: kgm/s

Impulse: a change in momentum caused by a net force acting over a period of time.

equation: $\Delta p = F_{net}\,\Delta t$

impulse is also a vector

units: kgm/s = Ns (N=kgm/s^2 so Ns = kgms/s^2)

eg. A 0.450kg baseball is moving at 100 miles/hour
100 miles/hour(1.6km/mile)(1000m/km)(h/3600s)
= 100x(1.60934)x1000/3600=44.70389
44.7 m/s

you hit it with a bat and goes back at -50.0m/s
if the ball is in contact with the bat for 0.0200s

a) what is the momentum of the ball before and after contact?
b) what is the impulse on the ball? on the bat?
c) what is the force on the ball? on the bat?
d) keeners: impulse = area under a F-t graph. sketch the F-t graph if the force increases and decreases linearly

homework p178-180 Q1-4, CR 1.1-1.4
next class collab day - introduce conservation of momentum
Lab Thursday

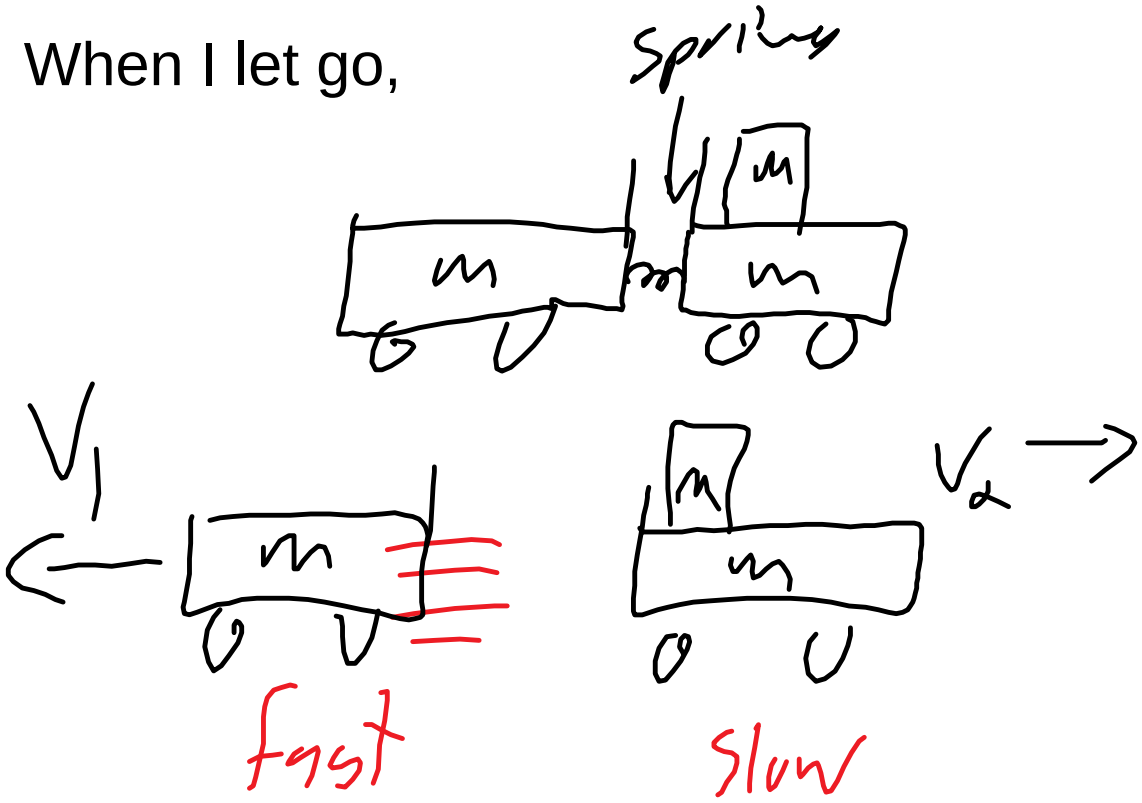
Momentum and Impulse

demo:

2 carts with a spring between them

When I let go, Spring

When I let go,



The spring pushes on both carts with equal and opposite forces, the cart with more mass accelerates less a=F/m if m is big, a is small for the same F.

since $a=\Delta v/\Delta t$ $v_1>v_2$ since m+m>m

this relationship between mass and velocity is a useful one in physics, so we give it a name:

Momentum is the product of mass and velocity. Vector quantity. Direction must be considered.

symbol: p (why p? no one knows for sure but greek pneumatic is related to pressure, so maybe that's it)

equation: $p=mv$

units: kgm/s (no special units)

Impulse: a change in your momentum caused by a net force acting over a period of time.

equation: $\Delta p=F_{net}\,\Delta t$

units: kgm/s or Ns
N= kgm/s^2 Ns = $kgms/s^2$ = kgm/s

eg. A 0.450 kg baseball is thrown at 107 miles/hour = ? m/s
107miles/h(1.61 km/mile)(1000m/km)(1h/3600s)

107x1.61x1000/3600=47.8528
47.9m/s
you hit the ball back at -50.0 m/s. If the bat contacts the ball for 0.0200s,

a) what is the momentum of the ball before and after?
b) what is the impulse on the ball? on the bat?
c) what is the force on the ball? on the bat?
d) bonus: keeners impulse = area under the F-t graph. sketch an F-t graph if it increases and decreases linearly.